Cal Data Logger Operation and Calibration

I. Purpose:

The purpose of this procedure is to describe the steps performed by the RESET team to field-calibrate the calibration logger using precision resistors and a voltage standard.

II. Cautions and Hazards:

- The voltage standard runs on 110 Volt AC power; only RESET team members trained in electrical safety conduct these procedures.
- Conduct these procedures at the data loggers if there is no reasonable chance of rain; If it is raining or may soon rain, then disconnect the data loggers from the data system. Log the beginning and ending time in the DAQC calibration form, and move the datalogger indoors for calibration.
- Although most of the following steps only check voltage into voltage logged, it is still a good idea to download the current configuration file for the data logger and make sure the calibration factors are correct for the instruments actually used. (This is done within the ZENO menu of the logger [system load menu] type ***xT*** to transmit configuration file using TERM.)

III. Requirements:

- A CAL Data logger.
- Reference Sensors.
- Notebook PC with RS232/EI422/Impulse Adapter Cable.
- Checkout Equipment (as specified by Sensor Mentors).
- Reference Standard Voltage Source.
- Calibrated Digital Multimeter.
- Precision Resistors.
- 6- and 8-Pin Break-Out Boxes.
- RS422/232 Data Conversion Box.
- Computer with Terminal Emulation Software.

IV. Procedure:

Note: You ***must*** connect a high quality ground to the Data Logger case before continuing with the rest of the procedure. If the data logger does not have a good

ground reference, a significant offset on the A/D measurements occurs. We have also found that when calibrating each channel separately, the input for the channels not under test need to be shorted. Failure to do so can produce a 10 to 70 microvolt variable offset. While conducting this procedure, log serial numbers, standard voltages, and resistances versus measured values on Excel-formatted, calibration forms (example attached).

Although these tests can be performed inside, if weather conditions permit, perform the following steps outside with all the sensors running (configuration and running instruments may, under some conditions, affect the calibration). Make sure a wire or resistor is connected between the voltage reference ground (black knobs) and the case of the reference.

A. Preliminary Steps:

1. Connect power to the datalogger.
2. Connect a notebook computer to the data logger, using the RS232/EIA422/Impulse adapter.
3. Turn ON power for the RE232/EAI1422 adapter.
4. Ensure that the time in the logger is correct as follows:

- *U*—user menu.
- F—system function.
- S—time and data.

5. Reset the date to 1990 to avoid Y2K and new logger configuration problems.
6. Proceed to the System Load Menu in the ZENO Program Menu.
7. Upload the appropriate configuration file to the CAL datalogger using X-Modem Transfer (enter "**XT**").

Note: For GNDRAD sensor comparisons use the file CALRAD.TXT; for the SKYRAD sensor comparisons, use the CALRAD.TXT when connecting a single PSP radiometer, or CALSKY.TXT when connecting two PSP sensors.

8. Connect the sensors to the datalogger.
9. After proceeding to the Sensor Menu in the ZENO Program Menu, check the calibration coefficients for the sensors in the ZENO Configuration, changing them as required.
10. Follow any procedures given by the Sensor/Instrument Mentors.
11. Verify that the ZENO is measuring all signals properly by using the Test Menu to view raw (voltage) and scaled (calibrated) data.

12. View the PIR thermostat resistances and temperatures and the UVB temperature by selecting the System Functions Menu from the User Menu and enabling Real-Time Output (C4/1); then **QUIT**.
13. Verify that the ZENO is logging data using the Data Retrieval Menu.
14. If Real-Time Output is enabled, disable it (C4/0).
15. Save the configuration to EEPROM.
16. Enter "**QUIT**" before disconnecting the computer from the datalogger. **Note**: The new computer may be disconnected from the datalogger while data is being collected.
17. If necessary, download data from the ZENO to the notebook computer by reconnection via the RS232/EIA422/Impulse adapter.
18. Establish communications by entering "**U**" and proceed to the Data Retrieval Menu. **Note**: Entering "**XB**" downloads records logged between a starting date/time and an ending date/time.
19. Enter "**QUIT**" before disconnecting the notebook computer.
20. Enter a table of the serial number and calibrations for the sensors connected to the CAL datalogger into the appropriate logbook.
21. Send a copy or a listing of the sensor serial numbers and calibrations and the configuration file to the sensor mentors.

Note: When the CALRAD.TXT file is used, the following data is logged:

"TWP-Manus.calrad V970130.00", BIT, PSPC_Ave, PSPC_SD, PSPC_Max, PSPC_Min, PIRC_E_1, PIRC_E_2, PIRC_E_3, RCc_1, RCc_2, RCc_3, RCd_1, RCd_2, RCd_3, PIRC_Ave, PIRC_SD, PIRC_Max, PIRC_Min, IRTC_Ave, IRTC_SD, IRTC_Max, IRTC_Min. UVB_T_1, UVB_T_2, UVB_T_3, UVB_1, UVB_2, UVB_3, UVB_Ave, UVB_SD, UVB_Max, UVB_Min, NIP_Ave, NIP_SD, NIP_Ma, NIP_Min, NET_Ave, NET_SD, NET_Max, NET_Min, Int_Temp, PWR_Int, PWR_24V, PWR_Ext

Note: When the CALSKY.TXT file is used, the following data is logged: "TWP-Manus.calsky V970130.00". BIT, PSP1C_Ave, PSP1C_SDPSP1C_Max, PSP1C_Min, PIRC_E_1, PIRC_E_2, PRC_E_3, RCc_1, RCc_2, RCc_3, RCd_1, RCd_2, RCd_3, PIRC_Ave, PIRC_SD, PIRC_Max, PIRC_Min, IRTC_Ave, IRTC_SD, IRTC_Max, IRTC_Min, UVB_T_1, UVB_T_2, UVB_T_3, UVB_1, UVB_2, UVB_3, UVB_Ave, UVB_SD, UVB_Max, UVB_Min, NIP_Ave, NIP_SD, NIP_Max, NIP_Min, PSP2C_Ave, , PSP2C_SD, PSP2C_Max, PSP2C_Min, Int_Temp, PWR_Int, PWR_24V, PWR_Ext

B. To Simulate a PIR Sensor:

1. Simulation of this sensor requires an 8-pin breakout or sensor substitution box.
2. Put precision resistors (4.125, 8.25, 17.5 K Ohm) across pins 2 and 3, and 7 and 8 (the 4.125 Ohm resistance is made with two 8.25 Ohm resistors in parallel).
3. Attach standard voltage source across pin 4 (minus) and pin 5 (plus).
4. Connect breakout or sensor substitution box to connector 2 (or 6) on CAL logger CAL PIR data logger.
5. Disconnect connector Term (to ADaM) and connect RS422 converter box.
6. Connect 9-pin connector on the converter box to computer with terminal emulator software (communications at 9600baud, com1, 8 bits, 1 stop bit, No Parity, Xon/Xoff).
7. Press U (no carriage return) to establish communications with the ZENO.
8. Select the Test Menu.
9. Press R for raw data in volts.
10. Examine PIR (or PIRD) data channels with 0, 0.5, and 1mV selected from the voltage source.
11. Log differences between input and output, time, and date in calibration data sheets.
12. If offset greater than 15 microvolts is observed, check voltage source with calibrated Digital Multimeter. (If difference between voltage source and digital Multimeter is greater than 4 uV, contact instrument mentor).
13. If offset confirmed to lead is greater than 4 W/m2 (about 16 uV), contact mentor; if mentor agrees, change ZENO voltage calibration offset (see below).
14. Change to user menu (press U).
15. Type F for system function menu.
16. Type C4/1 to make real-time output format.
17. Type Q to quit.
18. Examine Case and Dome resistances for PIRG (or PIRD).
19. Log differences between input and measured resistances, time, and date on calibration data sheet.

20. If differences are greater than 0.2%, check resistances with calibrated Digital Multimeter and repeat.
21. If differences greater than 0.2% persist, contact mentor and, if agrees, change fixed resistor calibration (see below). **(This step and the following are very IMPORTANT, ADaM data could be corrupted).**
22. Disable real time output by selecting System Function Menu and typing C4/0
23. Quit to terminate connection.

C. To Change Voltage Calibration:

1. Calculate offset voltage and gain that produces the best value in W/m2 (#uV* calibration coefficient [example: 279330 to add an offset of 10 mV would put 2.7933 into C] at a voltage level that corresponds to a median daytime value (0.6 mV); a voltage offset of 7 uV corresponds to about 2 W/m2.
2. Find the ratio of expected versus measured values in the same units.
3. Change to Sensor Menu in ZENO Program Menu.
4. Change the calibration factors (usually only the offset conversion coefficient C) in the Sensor menu (see Sensor Configuration Table).
5. Redo the instrument test steps above to make sure corrected calibration leads to acceptable differences between expected and measured values (less than 4 W/m2).
6. Go to Data Output Menu and change the version number (use Capital V).
7. Return to ZENO Program Menu.
8. Type E to save settings to EPROM.
9. Save the configuration using XT and the Windows transfer menu.
10. In term, after XT press Alt T and click on receive binary file.
11. Quit to terminate connection.
12. After disconnecting instrument-simulating equipment, reconnect data logger with original connections.
13. Make certain that the new configuration file is loaded to ADaM.
14. Send copies of new configuration to mentor, TWPPO, and Bill Porch.
15. Follow communication of data to mentor procedure PRO(CAL)-***??*** (to be written).

D. To Change PIR Fixed Resistor Calibration for Resistance and Voltage Offset Differences

1. Determine ratio of input resistance and output that best balances both calibration resistance values for 4125 and 8250 Ohms for each channel (Case and Dome).
2. Multiply this ratio by value currently used (close to 10000) in the respective process (see attachments 3 and 5, CAL logger Sensor Configuration Tables for process number).
3. Go to ZENO Processing Menu by pressing Z.
4. Move or jump to the processes for the PIRG or PIRD channels to be changed.
5. Change the resistance values to the one calculated in step 2; change the resistance values at three locations for each resistance value change; in processes 4, 7, 26, and 29 enter the resistance value for the slope and minus the resistance value as the offset (the last two items).
6. Press Q to quit; wait several minutes for the changes to take effect. (You may view the raw data from the Test Menu until non-zeros appear to be sure that the changes took effect.
7. From the system function menu, re-enable real time output (enter C4/1) and then quit to view the computed thermistor resistances.
8. Redo the instrument test steps above to make sure corrected calibration leads to acceptable differences between expected and measured values (less than 15 Ohms).
9. Go to user menu (U).
10. Press Z to return to ZENO program menu.
11. Press D to change to Data Output and change the version number (use capital V).
12. Type Z to return to ZENO Program Menu.
13. Type E to save settings to EPROM.
14. Save the configuration using XT and the Windows transfer menu.
15. Change C4/0 to disable real-time data format (IMPORTANT).
16. Quit to terminate the connection.
17. After disconnecting instrument-simulating equipment, reconnect data logger with original connections.

18. Make certain that the new configuration file is loaded to ADaM.

E. Simulate PSP, IRT,CAL Logger, and NETCAL Logger

1. These sensors require the 6-pin breakout box.
2. Connect voltage standard between pins 2 (negative) and 3 (positive) on breakout box.
3. Plug breakout box into PSP1, PSP2, IRT, NIP for NET.
4. Insert the following voltages:
   - PSP 0, 6, and 12 mV
   - IRT 0, 0.5, and 1 V
   - NIP 0, 6, and 12 mV
   - NET -9.5, 45, and 95 mV
5. Compare input and output voltages from the raw data.
6. If values differ by more than insignificant values listed below, contact mentor and possibly change the offset and gain following the same procedures above for voltage calibration changes for the PIR (see attachments at the end of this document).

F. Simulate UVBCAL Logger:

1. Connect voltage standard between pins 2 (negative) and 3 (positive) and pins 2 and 6 for UVB_UV and UVB_T, respectively, on the 8-pin breakout box; disconnect the resistors if necessary.
2. Connect the breakout box to CAL logger UVB on Calibration data logger.
3. Insert 0, 1.25, and 4 Volts on UVB_UV (pins 2 and 3).
4. Insert 0, 1, and 2 Volts on UVB_T (pins 2 and 6).
5. Compare input and output voltages from the raw data.
6. If values differ by more than the insignificant values listed below, contact mentor and possibly change the offset and gain following the same procedures above for voltage calibration changes for the PIR (see attachments at the end of this document).

Insignificant Voltage Offsets

PIR	PIR R	PSP	IRT	NIP	NET	UVB UV	UVB_T	Vin
16uV	20Ω	20uV	1mV	20uV	20uV	20mV	20mV	0.2V

G. Calibrate Datalogger voltage Divider for Power Level Sensing:

1. Use a Digital Multimeter to measure the input power voltage; adjust the calibration factor in the Sensor Menu (Sensor 13) to obtain the proper external battery voltage reading. (The latter is viewed by selecting the Scaled Sensor Data option from the ZENO Test Menu.)
2. Enter the calibration coefficients for the sensors into the ZENO configuration. (A ZENO Sensor Configuration Table is included in the SKYRAD Data Logger Installation Procedures.)

Note: Follow the following procedure elements (H,I,J and K) only if the Cal logger is to be used to record SMET data

H. To Calibrate the T/RH and Wind on the Calibration Datalogger:

1. Remove the Wind Monitor and place the Vane Angle Fixture on the orientation ring (**Important:** do not loosen or adjust lower orientation ring with notch for sensor unless initial orientation to North is incorrect).
2. Replace Wind Monitor on the Vane Angle Fixture.
3. Engage the indexing pins in the notches and tighten the clamps (also attach holding arm to the fixture).
4. Connect a notebook PC to the CAL data logger using the RS232/EIA422/Impulse adapter.
5. Step through the ZENO menus (U, T, and Scaled).
6. Use the Vane Angle Fixture to position the vane at 30 degree increments (except 360^{o} where there can be a 1 to 5 degree dead Zone) .
7. The ZENO should report wind directions within ±5 degrees of the Vane Angle Fixture settings. (If the instrument fails, replace sensor and try again; if it fails again, contact mentor and consider a voltage calibration of ZENO Data Logger [see below].)
8. Remove the Wind Monitor and Vane Angle Fixture.
9. Place the Wind Monitor on the orientation ring and engage the orientation-ring indexing pin in the notch at the instrument base.
10. Tighten the mounting-post, band clamp after carefully and evenly attaching to ONLY the rotating part of the anemometer (align with end of rotating part).
11. Connect the Anemometer Motor Drive to the propeller shaft.

12. Turn on the Motor Drive, set Motor for CW (clockwise), and set the speed to 200 RPM. (The ZENO Test Menu Raw Sensor Data should report a 10 Hz signal; achieving a steady 200 RPM may be difficult and several efforts at realigning the motor and anemometer shaft and/or moving in or out may be necessary.)
13. Set the speed to 400 RPM. (The ZENO should report a 20 Hz signal.)
14. Set the speed to 800 RPM. (The ZENO should report a 40 Hz signal.)
15. Set the speed to 1600 RPM. (The ZENO should report a 80 Hz signal.)
16. Set the speed to 3200 RPM. (The ZENO should report a 160 Hz signal.)
17. If testing Wind Monitor #1 (Input connector 3), check the calibration values for Sensor #1 for conversion from Hz to meters/sec.
18. If testing Wind Monitor #2 (Input connector 4), check the calibration values for Sensor #3 for conversion from Hz to meters/sec.
19. If the measured values in Hz differ by more than 5%, replace sensor; if difference still greater than 5%, contact mentor.
20. If changes are made to the Configuration, change the Configuration Version Number in the Data Output Menu to include the current date (use a capital V).
21. Save the changes to EPROM by pressing E.
22. Download the new configuration to the notebook computer.
23. Terminate the connection by selecting Quit.
24. Disconnect the notebook computer and connect the logger to ADaM.
25. Download the new SMET ZENO configuration to ADaM.
26. Send a copy of the calibration report to the Calibration and Instrument mentors.
27. If the SMET configuration was changed, send a copy or a listing of the new configuration file to the SMET mentor.

I. Calibrate T/RH (Both Logger and Sensor):

1. Connect the Temperature/Relative Humidity Probe to the SMET data logger.
2. Remove filter and put a watertight cover, e.g., a balloon, over the tip of the SMET probe; put about 5 cm of water (ice water if available) into a Dewer flask or Styrofoam cup and place it in the insulated box; put the

Reference Thermometer and the SMET probe into the water and close the lid.

3. Connect a notebook PC to the CAL data logger using the RS232/EIA422/Impulse adapter.
4. Select the ZENO System Function Menu and change the Real Time Output Format to ASCII (1).
5. Quit to view the output message.
6. Compare the ZENO temperature reading to the reference temperature and the ZENO resistance ratio to the Resistance/Temperature Table for the temperature.

Note: This is done by going to the user (U) Data Retrieval menu (D) and List last record (L1). (The average temperature is the 6th field after the time [example: TWP-Nauru.smet V9801300.00 98/03/06, 17:58:59, 40800, -0.10, 0.00, -0.10, -0.10, 5.66, 0.12, . .).

7. If they disagree, then
    - Change the multiplier in Process 4 up or down several hundredths or thousandths. (The value of this constant should be about 13.000.)
    - Quit to view the output message. (Wait several minutes for the change to take effect; you may view the raw data from the Test Menu until non-zeros appear, making sure that the changes took effect, and then quit to view the output message.)
    - If the temperatures do not agree within ±0.5°C, repeat steps 7a) and b) until they agree.
8. Remove the cup or flask from the insulated box; remove the watertight cover from the SMET probe; put the probe and the reference Vaisala sensor into the insulated box.
9. Use the Test Menu to view Scaled Sensor Data.
    - Compare the ZENO and reference RH values. (They should agree within 4%.)
    - If they do not agree, recalibrate the reference RH probe using calibrated RH sensor.
    - If after recalibrating the reference probe, there is still disagreement, then replace the SMET probe with one that has a current calibration.
    - If the probe is replaced, repeat the temperature calibration of the temperature sensor (steps 2 through 9).

- If the SMET and reference reading still do not agree, calibrate the data logger.
- If the probe is replaced, perform a salt solution calibration on the old probe.
- If it cannot be properly adjusted, replace the Humidicap (P/N 16663HM) and recalibrate the probe.

10. If it still cannot be properly adjusted, return the probe to Vaisala for repair.
11. If a change is made to the configuration from the Data Output Menu, change the Configuration Version Number to include the current date.
12. From the ZENO System Function Menu change the Real-Time Output Format to none (0).
13. If a change is made to the configuration, save the changes to EPROM.
14. Download the new Configuration into the notebook computer.
15. Quit to terminate the connection.
16. Disconnect the notebook computer and connect the logger to ADaM.
17. Download the new SMET ZENO configuration to ADaM.
18. Send a copy of the calibration report to the Calibration and Instrument mentors.
19. If the SMET configuration is changed, send a copy or a listing of the new configuration file to the SMET mentor.

J. Installation of the Probe into the Aspirated Radiation Shield:

1. Slide the adapter ring over the probe from the sensor end, up towards the cable.
2. Screw the locking nut into the top of the aspirator, opposite the cone and rain shield.
3. Slide the probe through the locking nut and adjust the position of the adapter ring so that the sensor end is even with the end of the inner tube of the shield (cone).
4. While holding the probe to prevent it from twisting, tighten the locking nut until the probe is held firmly. (Do not over tighten the nut.)
5. Use a small cable tie to attach the cable to the probe so that the cover slides over easily; do not make a sharp bend in the cable.

6. Slide the cover over the probe so that the cable exits the cover through the notch in the cover. (This notch should face the back, or motor end, of the aspirator.)
7. Using some clear packing tape, tape the cover in place, by wrapping the tape around the seam.
8. Using some black cable ties, secure the cable to the aspirator tube.

K. Using Voltage Reference to Calibrate the Optical Rain Gauge (Both Logger and Sensor) or the Data Logger RH and Wind Direction Channels (if Necessary):

1. Compare average rain rate multiplied by the duration of rain to total rainfall measurements; if difference consistently significant (greater than 50%), check SMET data logger.
2. Connect voltage standard to pins 3 (Positive) and 4 (negative) on 6-pin breakout box.
3. Remove connector 1 on SMET data logger and connect break-out box.
4. Connect a notebook PC to the SMET data logger using the RS232/EIA422/ Impulse adapter.
5. Select the ZENO System Function Menu and change the Real Time Output Format to ASCII (1).
6. Quit to view the output message.
7. Input 0 V, 25 mV, 1V, 3V, and 5V.
8. If measured outputs differ by more than 5% contact mentor and consider replacing SMET datalogger.

Note: If RH voltage reference simulation is necessary, follow the steps above using the 8-pin breakout box and connector 2. Connect the reference voltage across pins 3(plus) and 2(minus) and input voltages 0 V, 0.5V, and 1.0 V.

Note: If wind direction voltage reference simulation is necessary, follow the steps above using connector 3 for WIND1 and connector 4 for WIND2. Connect the reference voltage across pins 5 (plus) and 6 (minus) and input voltages 0 V, 1 V, and 2.5 V.

V. References:

1. Coastal Environmental Systems, "Acceptance Procedures," 1995.
2. ZENO Corp., "Zeno-3200 Users Manual," May, 1995.

VI. Attachments:

1. Thermistor/Process Menu # Chart
2. Insignificant Voltage Offsets Chart
3. Sky Logger Sensor Configuration Table
4. Processes for CAL Logger Fixed Resistors Chart
5. Cal Logger Data Output Table
6. Example of Cal Logger Configuration File
7. ARCS Calibration Form
8. Example of Completed Form
9. Enter and Exit GNDRAD and SMET ZENO CONFIG Process

Attachment 1

Thermistor/Process Menu

Thermistor	Process Menu #
PIRG Case	4&5
PIRG Dome	7&8
PIRD Case	26&27
PIRD Dome	29&30
PIRDN Case	4&5
PIRDN Dome	7&8

Attachment 2

Insignificant Voltage Offsets

PIR	PIR R	PSP	IRT	NIP	NET	UVB_UV	UVB_T	Vin
16uV	20W	20uV	1mV	20uV	20uV	20mV	20mV	0.2V

Attachment 3

SKYRAD Sensor Configuration Table

When installing or changing the following sensors or instruments, the calibration coefficients need to be written into the appropriate ZENO Sensor Menu. The offsets in the Sensor Menu and the values of the fixed resistors in the Process Menu for the PIR thermistors should only be changed as a result of a datalogger calibration using 0.1% precision resistors.

Sensor or Instrument	Designation	Sensor Menu No.	Connector No.
Global Pyrgeometer	PIRG	4	2
Diffuse Pyrgeometer	PIRD	5	6
Global Pyranometer	PSPG	1	1
Diffuse Pyranometer	PSPD	2	5
Pyroheliometer	NIP	3	7
Infra-Red Thermometer	IRT-UP	6	3
UVB Temperature	UVB-T	7	4
UVB Signal	UVB-UV	8	4

Attachment 4

Processes for CAL LOGGER Fixed Resistors

Thermistor	Process Menu No's
PIRG Case Themistor	4 & 5
PIRG Dome Thermistor	7 & 8
PIRD Case Thermistor	26 & 27
PIRD Dome Thermistor	29 & 30

In processes 4, 7, 26, and 29 enter the resistance value for the slope and minus the resistance value as the offset (the last two items).

Attachment 5

Cal Logger Data Output Table

Site ID	Version #	Date

time	Bit	PSP 1c Ave	PSP 1c sd	PSP 1c max	PSP 1c min	PIRC_E1	PIRC_E2	PIRC_E3	RCc_1	RCc_2

RCc_3	RCc_1	RCc_2	RCc_3	PIRC Ave	PIRC sd	PIRC max	PIRC min	IRT Ave	IRT sd	IRT max	IRT min

UVBT_1	UVBT_2	UVBT_3	UVB_1	UVB_2	UVB_3	UVB Ave	UVB sd	UVB max	UVB min

NIP Ave	NIP sd	NIP max	NIP min	PSP 2C Ave	PSP 2C sd	PSP 2C max	PSP 2C min	Int temp	Int temp	Int pwr	24v pwr	pwr ext

Attachment 6
Example of Cal Logger Configuration File

```
* Zeno 3200 System Setup File
* Program Version And Date: Zeno 3200 V1.60-768-4, Jun  3 1995
* Copyright (C) Coastal Environmental Systems, 1995.
* Setup File Date And Time: 90/06/29 22:46:57
PARAM1 60 0 60 2 110 4 102 0 9600 9600
PARAM2 9600 0 0 0 0 3 0 0 0 0
PARAM3 16777 1 60 18 600 20 0 0 2 2
PARAM4 2 2 0 0 0 3276800
PARAM5 NONE NONE
SENSOR 3 "PIR1CGbl" 1 2 0 0 0 0 0 1 0 2 0 264550 0 0
SENSOR 3 "PSP1CGbl" 2 2 2 0 0 0 0 1 0 2 0 139548 0 0
SENSOR 3 "NIP1CTop" 3 2 2 0 0 0 0 1 0 2 0 121344 0 0
SENSOR 3 "PSP2CDif" 4 2 2 0 0 0 0 1 0 2 0 125298 0 0
SENSOR 3 "PIR2CDif" 5 2 0 0 0 0 0 1 0 2 0 260417 0 0
SENSOR 3 "NIP2Cbtm" 6 2 2 0 0 0 0 1 0 2 0 122444 0 0
SENSOR 1 "IRTC" 10 0 1 6 0 0 60 1 0 2 0 95 -60 0
SENSOR 1 "UVB_UV" 11 0 0 0 0 0 0 1 0 2 0 0.233 0 0
SENSOR 1 "UVB_T" 12 0 3 0 0 0 0 1 0 2 0 50 -25 0
SENSOR 1 "THER-1C" 8 0 0 0 2 1 0 1 0 2 0 -0.4 1 0
SENSOR 1 "THER-1D" 9 0 0 0 2 1 0 1 0 2 0 -0.4 1 0
SENSOR 1 "THER-2C" 14 0 0 0 2 1 0 1 0 2 0 -0.4 1 0
SENSOR 1 "THER-2D" 15 0 0 0 2 1 0 1 0 2 0 -0.4 1 0
SENSOR 1 "PWR_24V" 1 0 2 0 0 0 0 2 1 3 0 9.3 0 0
SENSOR 1 "PWR_INT" 2 0 0 0 0 0 0 2 1 3 0 1 0 0
SENSOR 1 "Int_Temp" 3 0 0 0 0 0 0 1 0 3 0 1 0 0
PROCESS 1 2 S2.1
PROCESS 3 2 S2.1 1400 -20 12
PROCESS 5 9 S10.1
PROCESS 5 8 P3.1 0 0 0 0 0 10000 -10000
PROCESS 4 1 S10.1 0.00103085 0.000238918 1.57464e-07 10000
PROCESS 5 9 S11.1
PROCESS 5 8 P6.1 0 0 0 0 0 10010 -10010
PROCESS 4 1 S11.1 0.00103085 0.000238918 1.57464e-07 10001
PROCESS 4 5 P8.2 P5.2 S1.1 1 4
PROCESS 1 9 S1.1
PROCESS 1 9 P4.1
PROCESS 1 9 P7.1
PROCESS 1 2 P9.2
PROCESS 3 2 P9.2 475 375 13
PROCESS 1 2 S7.1
PROCESS 3 2 S7.1 35 -60 14
PROCESS 4 3 S9.1 S8.1
PROCESS 1 9 S9.1
PROCESS 1 9 S8.1
PROCESS 1 2 P17.2
PROCESS 3 2 S9.1 26 24 15
PROCESS 3 2 P17.2 1.2 0 16
PROCESS 1 2 S3.1
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PROCESS 3 2 S3.1 950 -20 17
PROCESS 1 2 S4.1
PROCESS 3 2 S4.1 1400 -20 18
PROCESS 5 9 S12.1
PROCESS 5 8 P27.1 0 0 0 0 0 9997 -9997
PROCESS 4 1 S12.1 0.00103085 0.000238918 1.57464e-07 9997
PROCESS 5 9 S13.1
PROCESS 5 8 P30.1 0 0 0 0 0 9996 -9996
PROCESS 4 1 S13.1 0.00103085 0.000238918 1.57464e-07 9999
PROCESS 4 5 P32.2 P29.2 S5.1 1 4
PROCESS 1 9 S5.1
PROCESS 1 9 P28.1
PROCESS 1 9 P31.1
PROCESS 1 2 P33.2
PROCESS 3 2 P33.2 475 375 19
PROCESS 1 2 S6.1
PROCESS 3 2 S6.1 950 -20 20
PROCESS 3 1
PROCESS 1 1 S14.1
PROCESS 1 1 S15.1
PROCESS 1 1 S16.1
DATA 6 1,2 "TWP-" 1.1 0 0 1
DATA 6 1,2 "Nauru." 1.1 0 0 1
DATA 6 1,2 "calsky<20>" 1.1 0 0 1
DATA 6 1 "V000629.00" 1.1 0 0 1
DATA 6 1 "<20>" 1.1 0 0 1
DATA 3 1,2 "" 1.1 0 0 1
DATA 8 1 "BIT" 41.1 0 0 6
DATA 8 1 "PSP1_Ave" 1.1 2 0 8
DATA 8 1 "PSP1_SD" 1.3 2 0 8
DATA 8 1 "PSP1_Max" 1.4 2 0 8
DATA 8 1 "PSP1_Min" 1.5 2 0 8
DATA 8 1 "PIR1_E_1" 10.10 2 0 8
DATA 8 1 "PIR1_E_2" 10.30 2 0 8
DATA 8 1 "PIR1_E_3" 10.50 2 0 8
DATA 8 1 "RC1c_1" 11.10 2 0 8
DATA 8 1 "RC1c_2" 11.30 2 0 8
DATA 8 1 "RC1c_3" 11.50 2 0 8
DATA 8 1 "RC1d_1" 12.10 2 0 8
DATA 8 1 "RC1d_2" 12.30 2 0 8
DATA 8 1 "RC1d_3" 12.50 2 0 8
DATA 8 1 "PIR1_Ave" 13.1 2 0 8
DATA 8 1 "PIR1_SD" 13.3 2 0 8
DATA 8 1 "PIR1_Max" 13.4 2 0 8
DATA 8 1 "PIR1_Min" 13.5 2 0 8
DATA 8 1 "IRTC_Ave" 15.1 2 0 8
DATA 8 1 "IRTC_SD" 15.3 2 0 8
DATA 8 1 "IRTC_Max" 15.4 2 0 8
DATA 8 1 "IRTC_Min" 15.5 2 0 8
DATA 8 1 "UVB_T_1" 18.10 2 0 8
DATA 8 1 "UVB_T_2" 18.30 2 0 8
```

```
DATA 8 1 "UVB_T_3" 18.50 2 0 8
DATA 8 1 "UVB_1" 19.10 4 0 8
DATA 8 1 "UVB_2" 19.30 4 0 8
DATA 8 1 "UVB_3" 19.50 4 0 8
DATA 8 1 "UVB_Ave" 20.1 4 0 8
DATA 8 1 "UVB_SD" 20.3 4 0 8
DATA 8 1 "UVB_Max" 20.4 4 0 8
DATA 8 1 "UVB_Min" 20.5 4 0 8
DATA 8 1 "NIP1_Ave" 23.1 2 0 8
DATA 8 1 "NIP1_SD" 23.3 2 0 8
DATA 8 1 "NIP1_Max" 23.4 2 0 8
DATA 8 1 "NIP1_Min" 23.5 2 0 8
DATA 8 1 "PSP2_Ave" 25.1 2 0 8
DATA 8 1 "PSP2_SD" 25.3 2 0 8
DATA 8 1 "PSP2_Max" 25.4 2 0 8
DATA 8 1 "PSP2_Min" 25.5 2 0 8
DATA 8 1 "PIR2_E_1" 34.10 2 0 8
DATA 8 1 "PIR2_E_2" 34.30 2 0 8
DATA 8 1 "PIR2_E_3" 34.50 2 0 8
DATA 8 1 "RC2c_1" 35.10 2 0 8
DATA 8 1 "RC2c_2" 35.30 2 0 8
DATA 8 1 "RC2c_3" 35.50 2 0 8
DATA 8 1 "RC2d_1" 36.10 2 0 8
DATA 8 1 "RC2d_2" 36.30 2 0 8
DATA 8 1 "RC2d_3" 36.50 2 0 8
DATA 8 1 "PIR2_Ave" 37.1 2 0 8
DATA 8 1 "PIR2_SD" 37.3 2 0 8
DATA 8 1 "PIR2_Max" 37.4 2 0 8
DATA 8 1 "PIR2_Min" 37.5 2 0 8
DATA 8 1 "NIP2_Ave" 39.1 2 0 8
DATA 8 1 "NIP2_SD" 39.3 2 0 8
DATA 8 1 "NIP2_Max" 39.4 2 0 8
DATA 8 1 "NIP2_Min" 39.5 2 0 8
DATA 8 1 "Int_Temp" 44.1 2 0 8
DATA 8 1 "PWR_Int" 43.1 2 0 8
DATA 8 1 "PWR_24V" 42.1 2 0 8
DATA 6 2 "<20>PIR1_Rc:" 1.1 0 0 1
DATA 7 2 "RCc" 4.1 2 0 1
DATA 6 2 "<20>PIR1_Rd:" 1.1 0 0 1
DATA 7 2 "RCd" 7.1 2 0 1
DATA 6 2 "<20>PIR1_Tc:" 1.1 0 0 1
DATA 7 2 "TCc<20>K" 5.2 2 0 1
DATA 6 2 "<20>PIR1_Td:" 1.1 0 0 1
DATA 7 2 "TCd<20>K" 8.2 2 0 1
DATA 6 2 "<20>PIR1_cor:" 1.1 0 0 1
DATA 7 2 "PIR1C" 9.2 2 0 1
DATA 6 2 "<20>PIR2_Rc:" 1.1 0 0 1
DATA 7 2 "RCc" 28.1 2 0 1
DATA 6 2 "<20>PIR2_Rd:" 1.1 0 0 1
DATA 7 2 "RCd" 31.1 2 0 1
DATA 6 2 "<20>PIR2_Tc:" 1.1 0 0 1
```

DATA 7 2 "TCc<20>K" 29.2 2 0 1
DATA 6 2 "<20>PIR2_Td:" 1.1 0 0 1
DATA 7 2 "TCd<20>K" 32.2 2 0 1
DATA 6 2 "<20>PIR2_cor:" 1.1 0 0 1
DATA 7 2 "PIR2C" 33.2 2 0 1
DATA 6 2 "<20>UVB_cor:" 1.1 0 0 1
DATA 7 2 "UVB" 17.2 4 8 1
DATA 6 1,2 "<0D><0A>" 1.1 0 0 1

Attachment 7
ARCS Calibration Form FM(DAQ)-001

ARCS SKYRAD and GNDRAD Data Logger Field Calibration Form

I. Calibration information

	Calibration	Calibration Check	Field Calibration
This is a (check which):			X

Date:	GMT Begin Time:	GMT End Time:	ARCS #

Instrument / System:	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
CAL ZENO Datalogger	ZENO-3200(RAD)	
GNDRAD1 ZENO Datalogger	ZENO-3200(RAD)	

Current Configuration Version:	New Configuration Version

Location (eg. PNNL, Manus):	Participant(s):	Issued by:	Signature(s):

Reference Instrument(s):	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
Voltage source (Val)	2701C	
Voltmeter Fluke (Flk)	8842A	

Precision Resistors 4018, 8240, and 17790 Ohms

Verify that serial numbers of reference instruments are correct (yes / no)	
Verify calibration coefficients and configuration file changed accordingly for PIRs, PSPs, and NIPs. (yes / no)	

NOTES:

II. Initial Values

Sensor / Element Connection Location	Reference Target (Val) Actual (Flk)	Reading Actual or Range (µV)	Reference Target (Val) Actual (Flk)	Reading Actual or Range	Reference Target (Val) Actual (Flk)	Reading Actual or Range
PIRG Signal	0.0µV		500.0µV		1000.0µV	
Connector 2	Short		500		1000	
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3						
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	Short		500		1000	
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3	4017		8245		17785	
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8	4024		8257		17789	
PSP1G	0.0µV		6000.0µV		12000.0µV	
Connector 1	Short		6000		12000	
PSP2D	0.0µV		6000.0µV		12000.0µV	
Connector 5	Short		6000		12000	
NIP1	0.0µV		6000.0µV		12000.0µV	
Connector 7	Short		6000		12000	
NIP2	0.0µV		6000.0µV		12000.0µV	
	Short		6000		12000	

Were there calibration changes?(yes/no) **No?**

II. Final Values

Sensor / Element Serial Number:	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual
PIRG Signal	0.0µV		500.0µV		1000.0µV	
Connector 2	short					
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3						
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	short					
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3						
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PSPG	0.0µV		6000.0µV		12000.0µV	
Connector 1	short					
PSPD	0.0µV		6000.0µV		12000.0µV	
Connector 5	short					
NIP	0.0µV		6000.0µV		12000.0µV	
Connector 7	short					
PSP Dn	0.0µV		6000.0µV		12000.0µV	
	short					

IV. Statistics(if applicable)

No. of Samples:	Std. Dev.	CF Range %	Uncertanty %

V. Calilbration Change (if applicable)

Sensor or Parameter		Sensor Serial No.	Internal Resistance (Ohms)	Original Sensitivity (Volts/Unit)	Offset	Quadratic
		Old	Old	Old	Old	Old
		New	New	New	New	New
	Old					
	New					
	Old					
	New					
	Old					
	New					
	Old					
	New					
	Old					
	New					
	Old					
	New					
	Old					
	New					
	Old					
	New					

Document(s) Referenced:

PRO(DAQR)-001.001

Document(s) Updated:

PRO(DAQC)-001.003

PROBLEMS:

Attachment 8
Example of Completed Form

ARCS SKYRAD and GNDRAD Data Logger Field Calibration Form

I. Calibration information

This is a (check which):	Calibration	Calibration Check	Field Calibration
			X

Date:	GMT Begin Time:	GMT End Time:	ARCS #
27/06-07/00	23:05	1:15	2

Instrument / System:	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
CAL ZENO Datalogger	ZENO-3200(RAD)	823
GNDRAD1 ZENO Datalogger	ZENO-3200(RAD)	

Current Configuration Version:	New Configuration Version
V000331.00	V000627.00

Location (eg. PNNL, Manus):	Participant(s):	Issued by:	Signature(s):
Nauru	Kornke		
	Porch		

Reference Instrument(s):	TWP OMS Part Number(s):	TWP OMS Serial Number(s):
Voltage source (Val)	2707A	26-1348
Voltmeter Fluke (Flk)	8842A	6750251

Precision Resistors 4020, 8250, and 16210 Ohms

Verify that serial numbers of reference instruments are correct (yes / no)	yes
Verify calibration coefficients and configuration file changed accordingly for PIRs, PSPs, and NIPs. (yes / no)	yes

NOTES:

Instruments installed in field for first cal. Comparison:

Instrument	S/N	coef x E-6	cal coef	channel
PIR	30167F3	4.43	225733	PIR1
PIR	31301F3	3.34	299401	PIR2
PSP	31275F3	7.84 NREL	127551	PSP1
PSP	31274F3	7.803NREL	128155	PSP2
NIP	31347E3	8.241NREL	121344	NIP1
NIP	31346E3	8.261NREL	121050	NIP2

II. Initial Values

Sensor / Element Connection Location	Reference Target (Val) Actual (Flk)	Reading Actual or Range	Reference Target (Val) Actual (Flk)	Reading Actual or Range	Reference Target (Val) Actual (Flk)	Reading Actual or Range
PIRG Signal	0.0µV	(µV)	500.0µV		1000.0µV	
Connector 2	Short	-1.34 to -.937	500	5007 to 4996	1000	1000.7 to 994.2
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3	4023	4020	8252	8245	16202	16195
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8	4022	4024	8248	8255	16203	16211
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	Short	-1.4 to -2.1	500	499.9 to 488.6	1000	999.1 to 998.6
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3	4017	4019	8245	8255 to 8242	17785	16190
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8	4024	4018	8257	8241	17789	16189
PSP1G	0.0µV		6000.0µV		12000.0µV	
Connector 1	Short	-2 to -6	6000	6009 to 6004	12000	12017 to 12014
PSP2D	0.0µV		6000.0µV		12000.0µV	
Connector 5	Short	-3.7 to -3.8	6000	5996 to 5995	12000	12017 to 12014
NIP1	0.0µV		6000.0µV		12000.0µV	
Connector 7	Short	-2.6 to -3.4	6000	5999.7 to 5998.8	12000	11999 to 11995
NIP2	0.0µV		6000.0µV		12000.0µV	
	Short	1.0 to 2.5	6000	5983 to 6000	12000	12056 to 12050

Were there calibration changes?(yes/no) **No**

II. Final Values

Sensor / Element Serial Number:	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual	Reference Target (Val) Actual (Flk)	Reading Actual
PIRG Signal	0.0µV		500.0µV		1000.0µV	
Connector 2	short					
PIRG Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2 - 3						
PIRG Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PIRD Signal	0.0µV		500.0µV		1000.0µV	
Connector 6	short					
PIRD Rc	4000 Ω		8000 Ω		16000 Ω	
Pins 2-3						
PIRD Rd	4000 Ω		8000 Ω		16000 Ω	
Pins 7-8						
PSPG	0.0µV		6000.0µV		12000.0µV	
Connector 1	short					
PSPD	0.0µV		6000.0µV		12000.0µV	
Connector 5	short					
NlP	0.0µV		6000.0µV		12000.0µV	
Connector 7	short					
PSP Dn	0.0µV		6000.0µV		12000.0µV	
	short					

IV. Statistics(if applicable)

No. of Samples:	Std. Dev.	CF Range %	Uncertanty %

V. Calilbration Change (if applicable)

Sensor or Parameter	Sensor Serial No.	Internal Resistance (Ohms)	Original Sensitivity (Volts/Unit)	Offset	Quadratic
	Old	Old	Old	Old	Old
	New	New	New	New	New

Document(s) Referenced:
PRO(DAQR)-001.001

Document(s) Updated:

PROBLEMS:

NIP2 showed >50 uV offset problem when souse disconnected and reconnected (didn't see on NIP1 but it was offset during RESET10). Usually settles down in about 1 minute, but once or twice it would hang up with an offset. Suggest this time when instruments swaped we will turn logger off and on.

Attachment 9
Enter and Exit GNDRAD and SMET ZENO CONFIG Process

(Temporary Addenda to DAQ Calibration Procedures until Coastal Fixes Software Problem)

1. Connect to SKYRAD using telnet, terminal, hyperterminal, . . .
2. Enter **u<cr>** to bring up Zeno User Menu.
3. Enter **z<cr>** and the password **zeno<cr>** to go into Zeno Program Menu.

(Within Zeno Program make changes that are needed [example below].)

4. Enter **p<cr>** to go to the Process Menu.
5. Enter **j7<cr>** to go to process step 7.
6. Enter **c10/9972<cr>** to change the erroneous coefficient.

(End of example.)

7. Enter **z<cr>** to return to the Zeno Program Menu.
8. Enter **d<cr>** to enter the Data Output Menu.
9. Enter **j4<cr>** to go to data output line 4.
10. Enter **c3/Vyymmdd.00<cr>** where **yy** is the year (00), **mm** is the month, and **dd** is the day of the month.
11. Enter **z<cr>** to return to the Zeno Program Menu.
12. Enter **e<cr>** to save the change to **eeprom**.

Perform the following between steps 12 and 13 if the change is done locally instead of remotely:

12.a. Enter **l<cr>** to go to the System Load Menu.
12.b. Enter **xt<cr>** to transmit the config file to the local pc.
12.c. After the config file is received, enter **z<cr>** to return to the Zeno Program Menu.

13. Enter **r<cr>** and then **y<cr>** to reset the system.
14. Wait for the following response from the Zeno:

The system will now reset. Please wait.
Searching for flash logging memory . . .
Found Chip #1.
Found Chip #2.
Found Chip #3.
Found Chip #4.
Found Chip #5.
Found Chip #6.
Found Chip #7.
Found Chip #8.
Watchdog Reset
Please wait . . ./
ZENO-3200 using ZENOSOFT V1.85H-1403B2-1.1 Feb 22 1999 15:21:33 CS B300
©opyright 1995-1999, Coastal Environment Systems, Seattle, WA, USA.
System Tim = 00/01/05 18:56:16
Initializaing Zeno 3200 . . ./

Zeno 3200 is Data Sampling. Type 'U'<enter> to access the User Interface.
Note! The System Time will be the current Zeno date and time.

15. Disconnect from the Zeno.